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TOOLS FOR INQUIRY-BASED LEARNING IN PRIMARY SCHOOL

Abstract. Information technology and information literacy are becoming increasingly important in today's knowledge society. Many studies have shown that students from elementary school to graduate school do not have enough information literacy and skills in IT, therefore, there is a need for effective pedagogical approach that will develop these skills. One of the important step in this direction is the possibility of combining a collaborative teaching approach with inquiry-based learning to develop information literacy of elementary school students and IT skills. Based on existing theoretical framework, we believe that modern teaching technology should be used in early childhood. Children of primary school age explore and learn about the environment by using queries, and computer technologies offer available way to extend the domain and range of this request. A great number of interactive games and educational software packages have been implemented over the last decade for primary schools. However, a large number of software packages are not focused on inquiry-based learning. Examples of existing and hypothetical apps to research in early childhood presented in this article. Problems and future research directions are also identified and discussed.

Keywords: inquiry-based learning; learning environment; problem solving; primary school; technology; applications; tools; computers

One of the urgent tasks of modern school is the search for optimal ways to interest students learning, improve their mental alertness, motivation to work, education of students as vital and socially competent person, capable of independent choice and make responsible decisions in various situations and the process of formation skills practical and creative application of acquired knowledge. This means that the teacher should be oriented on using such educational technologies that would not only increase the knowledge and skills of a school subject, but also develop student abilities such as cognitive activity, independence, ability to perform tasks creatively. Cognitive activity of the individual indicates that the student is willing to absorb a particular information, in fact - has strong existing need for qualitative cognitive activity, strong and persistent motifs of this activity. Implementation inquiry-based learning in educational process requires a new organization based on planning joint activities of teachers and students. The modern teacher should encourage their students to be creative, to have innovative thinking, to research surrounding world and to be curious, to find new methods of problem solving. Inquiry-based learning provides the best implementation process of self-knowledge and creative thinking in children. Through this method pupils are always in a state of discovery, they learn to explore themselves, to describe events, to formulate hypotheses, to prove their convictions and so on.

Inquiry-based learning for younger students should be implemented under the guidance of a teacher and with his participation and help. Progressive teachers, with development of technology use opportunities of information and communication technologies (ICT) to improve the quality of didactic and methodological support of the educational process to identify of giftedness and personality of a student. In most modern schools learning activities, including research, requiring teachers' readiness to use ICT in their professional activities. In

these circumstances, one of the priorities of modernization and promotion of research studies is the use of electronic educational resources both during lessons and in overtime. Therefore, the study and use of tools for organizing inquiry-based learning, various virtual laboratories and integrated programs that help to reproduce fully or partially the progress of experiments, to see results and changes in correcting the conditions, to observe the natural phenomena, to explore surrounding world and to be involved in a scientific experiment will allow to improve the quality of didactic and methodological support of the educational process.

The problem of inquiry-based learning in the learning process considered an actual for a long time of teaching science. J. Komensky, J. Lock, J. Pestalozzi, K. Ushinskiy, M. Montessori and others pointed of the importance of independent search in education and upbringing. Research training methods used and actively developed both in the foreign and the domestic theory and practice (E. Parherst – US; O. Dekroli, P. Kerhomar - France; M. Montessori - Italy etc.), European educational practice "new schools" (E. Demolen - France, A. Feryer - Switzerland, C. Freinet - France, etc.). "Labor school" (G. Kershenshteyner - Germany), "Education Activity" (V. Lai - Germany, P. Kapterev - Russia and others) "Experimental pedagogy" (E. Meyman - Germany, E. Thorndike - USA). Scientific works B. Andreeva, T. Baybary, N. Bibik, V. Davydova, L. Zankova, O. Savenkova, J. Kodlyuk, V. Palamarchuk, O. Savchenko, and T. Chernetska devoted to the problem of formation in younger students educational and research activities.

The research activity of students refers to activities that are concerned with solving creative research problem with unknown solution. It provides for major phases that are characteristic for research in science: problem, learning theory, which is devoted to this issue, the selection methods of research and practical mastering them, collecting their own material, its analysis and synthesis, and their conclusions. This phased process is an essential accessory of inquiry-based learning, the norm for its implementation. Current global Internet offers a variety of electronic educational resources, which includes virtual laboratory of biology, anatomy, ecology, astronomy and more. However, they do not completely cover educational process. Before their use teacher should be well prepared for the implementation of the inquiry-based learning:

- choose exactly those experiments that will encourage cognitive activity, set realistic goals and tasks for students;
- help students to find the right solutions and have a balanced attitude to mistakes;
- involve discussion of ideas and hypotheses;
- to be a tutor during the search process of children, monitor the dynamics of interest to the object;
- to be able to stimulate creativity.

That is why more and more special modes that allows teachers to design lesson personally are included in the functionality of electronic educational resources. This lesson designer should ensure the creation of separate steps, the creation of new classes, adding to the created lesson and removing some steps of the lesson; import and export basic elements of lessons etc.

The purpose of the article is to study the characteristics and possibilities of using resources for inquiry-based learning in elementary school.

In studies of many educators and psychologists were noted that originality of thought, the ability to cooperate and creative skills of pupils are fully and successfully developing during activities, especially aimed at the research process. This fact is important for primary school students, because learning activity at this age is a leading and determining development of basic cognitive features of young student. Such quality of the individual, as research interest, is inherent especially for a child who has just come to school.

The term "Inquiry-based learning" entered in the professional sphere recently, in the second half of the XX century. While there is quite long history of using research methods trainings in educational practice. The term appeared first through the work of specialists in Comparative Education (M. Klarin), later it was actively used in their work the researchers in the field of educational psychology (A. Leontovich, A. Savenkov, etc.).

It should be noted that the main purpose of research in the field of education (as opposed to academic) is that it is educational that is its main purpose to develop student's personality rather than getting new objective result as a "big" science. The aim of inquiry-based learning is the development of students' functional skills research as a universal way of understanding of reality, the development of research type of thinking, activation of personal student positions in education through the acquisition of new knowledge (self-received knowledge that is new and personally meaningful for a particular student).

Inquiry-based learning is an approach to teaching and learning that places students' questions, ideas and observations at the centre of the learning experience. Educators play an active role throughout the process by establishing a culture where ideas are respectfully challenged, tested, redefined and viewed as improvable, moving children from a position of wondering to a position of enacted understanding and further questioning (Scardamalia, 2002, pp. 67–98). Underlying this approach is the idea that both educators and students share responsibility for learning.

For students, the process often involves open-ended investigations into a question or a problem, requiring them to engage in evidence-based reasoning and creative problem-solving, as well as "problem finding." For educators, the process is about being responsive to the students' learning needs, and most importantly, knowing when and how to introduce students to ideas that will move them forward in their inquiry. Together, educators and students co-author the learning experience, accepting mutual responsibility for planning, assessment for learning and the advancement of individual as well as class-wide understanding of personally meaningful content and ideas (Fielding, 2012, pp. 45–65).

Although inquiry-based learning is a pedagogical mindset that can pervade school and classroom life (Natural Curiosity, 2011) and can be seen across a variety of contexts, an inquiry stance does not stand in the way of other forms of effective teaching and learning. Inquiry-based learning concerns itself with the creative approach of combining the best approaches to instruction, including explicit instruction and small-group and guided learning, in an attempt to build on students' interests and ideas, ultimately moving students forward in their paths of intellectual curiosity and understanding.

There are many benefits to implementing inquiry-based learning programs. These benefits include the following (Fig. 1):

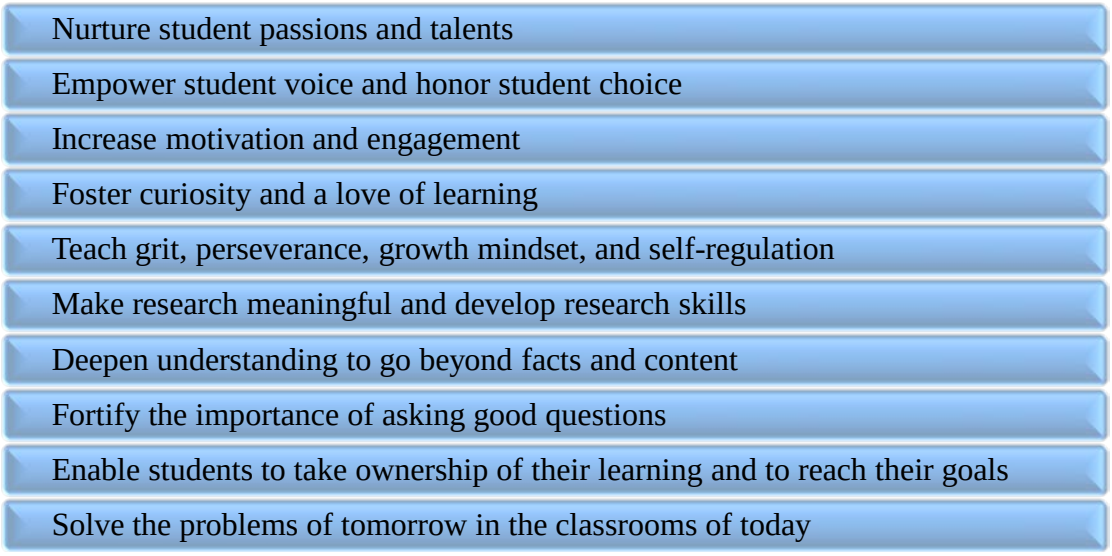

Figure 1. Benefits of Inquiry-Based Learning

There are many different explanations for inquiry teaching and learning and the various levels of inquiry that can exist within those contexts. The article titled The Many Levels of Inquiry by Heather Banchi and Randy Bell (2008) clearly outlines four levels of inquiry (Fig. 2).

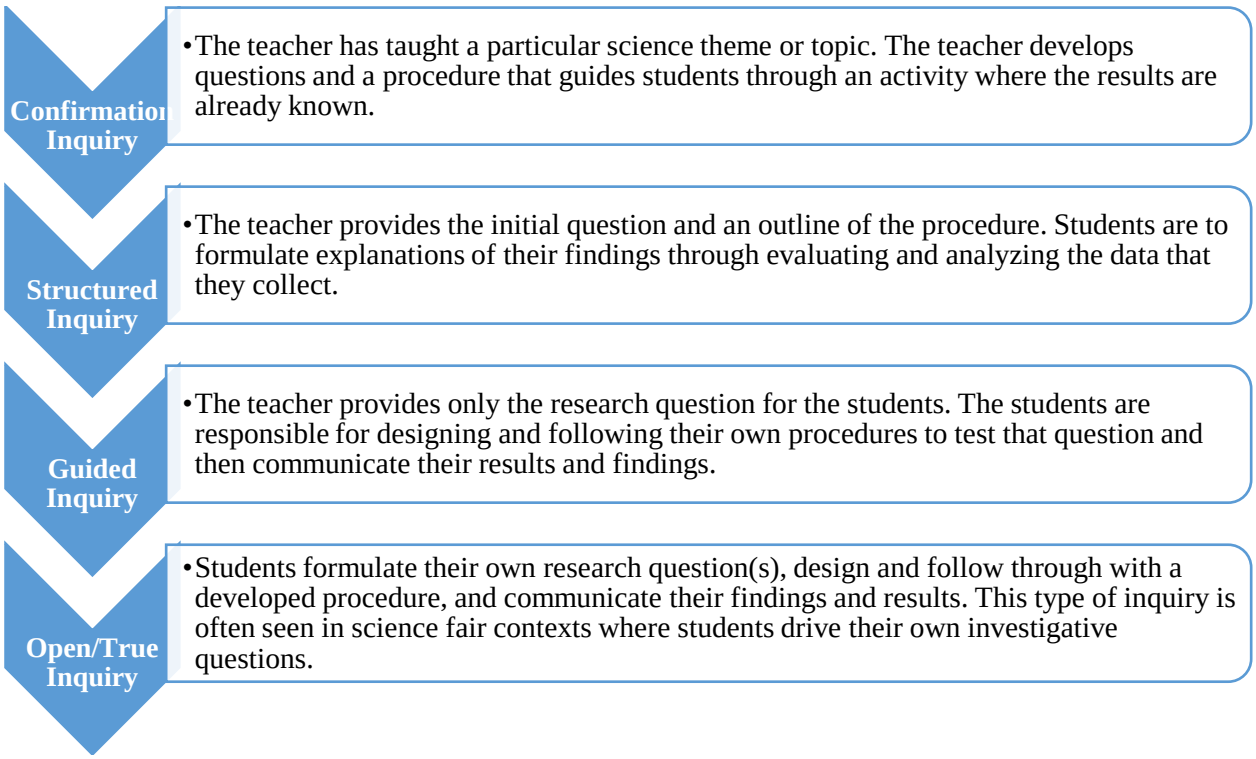

Figure 2. Levels of inquiry

As a learning strategy, inquiry-based learning is all about learners constructing their own understanding and knowledge through asking questions. Unlike traditional learning methods that focus primarily on drills, memorization and rote learning, inquiry-based learning is essentially student-centered. Curiosity and motivation lie at the heart of inquiry-based education. This approach to learning has turned traditional classrooms into high-energy learning centers, where children are excited to learn and participate. It starts with posing

questions and directly involves students in challenging hands-on activities that drive students to ask more questions and explore different learning paths.

Inquiry-based learning follows a three-step process that you can incorporate into many curriculums. Students ask themselves three questions about any new subject being introduced:

1. What do I already know about the subject?
2. What do I want to know about the subject?
3. What have I learned about the subject?

A KWL chart (What I know, what I want to know, what I've learned) is often used during these three steps to follow students' progress.

Inquiry based learning will be much more beneficial for students, because involvement in learning results in improvement of possessing skills and attitudes that permit you to seek resolutions to questions and issues while you build your new knowledge. There are many web tools that support inquiry based learning which teachers can use effectively to make all the students involve in the interaction.

In this article we have assembled a collection of some useful web tools and apps that support inquiry-based learning (Fig.3). Using these tools will enable students to engage in a wide range of learning tasks that are all driven by a sense of inquiry and questioning.

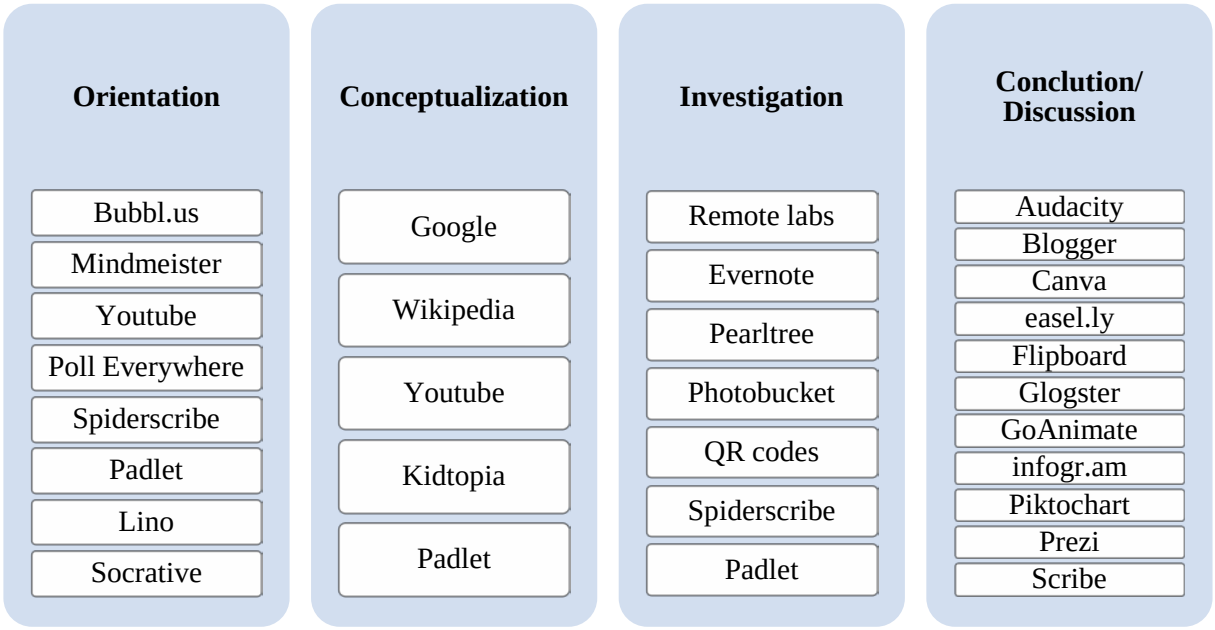

Figure 3. A collection of web tools and apps that support inquiry-based learning

But we will focus in more detail on the tool that allows us to implement all phases of the study. Educational portal **Go-Lab** (web site address: http://www.golabz.eu) offers a unique and broad set of remote and virtual laboratories. The online labs aim at supporting inquiry-based learning and providing the possibility to conduct scientific experiments in a virtual environment. The Go-Lab project offers access to scientific databases, tools, and resources supporting inquiry learning activities of the students.

Educational Portal Go-Lab designed for modern and creative teachers who want to attach their students to the world of science, knowledge and discoveries using complex development tasks for experiments. Leading experts from more than 15 countries involved into the creation and filling this portal. Experts from different spheres attached to its generation when creating learning resources and they can make competent advice to improve it. After the official confirmation of generated resource appears in the public domain and takes the appropriate place in the rating.

Teachers can fully use the educational portal, share experiences, participate in discussions and create high quality educational product. For this category Support Online presents: User manuals, Video tutorials, Tips & Tricks tutorial, Community forum, Online course, Forum.

You have to overcome only three steps to create space for inquiry based learning:

1. Find the online labs aim at supporting inquiry-based learning using Go-Lab repository (web site address: http://www.golabz.eu).
2. Create a unique environment just for your students with a variety of files, links and applications (web site address: http://www.graasp.eu).
3. Share resources with students (link generated by Graasp).

We describe these steps in more detail.

I stage. Users of educational portal can search for the necessary resources in 3 categories: *Online Labs, Apps, Big Ideas* (Fig. 4).

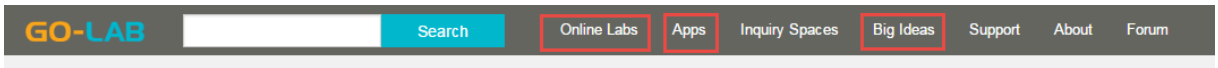

Figure 4. Menu bar educational portal Go-Lab

The portal "Online Labs" has 1500 online labs that can be used in the classroom, and adapted to educational needs and goals. *For example:*

1. *«Gravity Force Lab»*. It is possible to change properties of the objects in order to see how that changes the gravitational force between them.
2. *«Gear Sketch»*. The primary aims of the lab are: Let students to explore the ways in which gears and chains transmit motion.
3. *«Craters on Earth and Other Planets»*. In this lab, pupils can simulate the impact of an object (e.g., an asteroid) on the Earth, Moon or Mars.
4. *«The color of the light»*. Show to students how light and colors work on real life and how they are perceived.

To facilitate the search, you can sort the online laboratory using the right sidebar navigation (Fig. 5). Users are able to choose domain, user age, language and other resources.

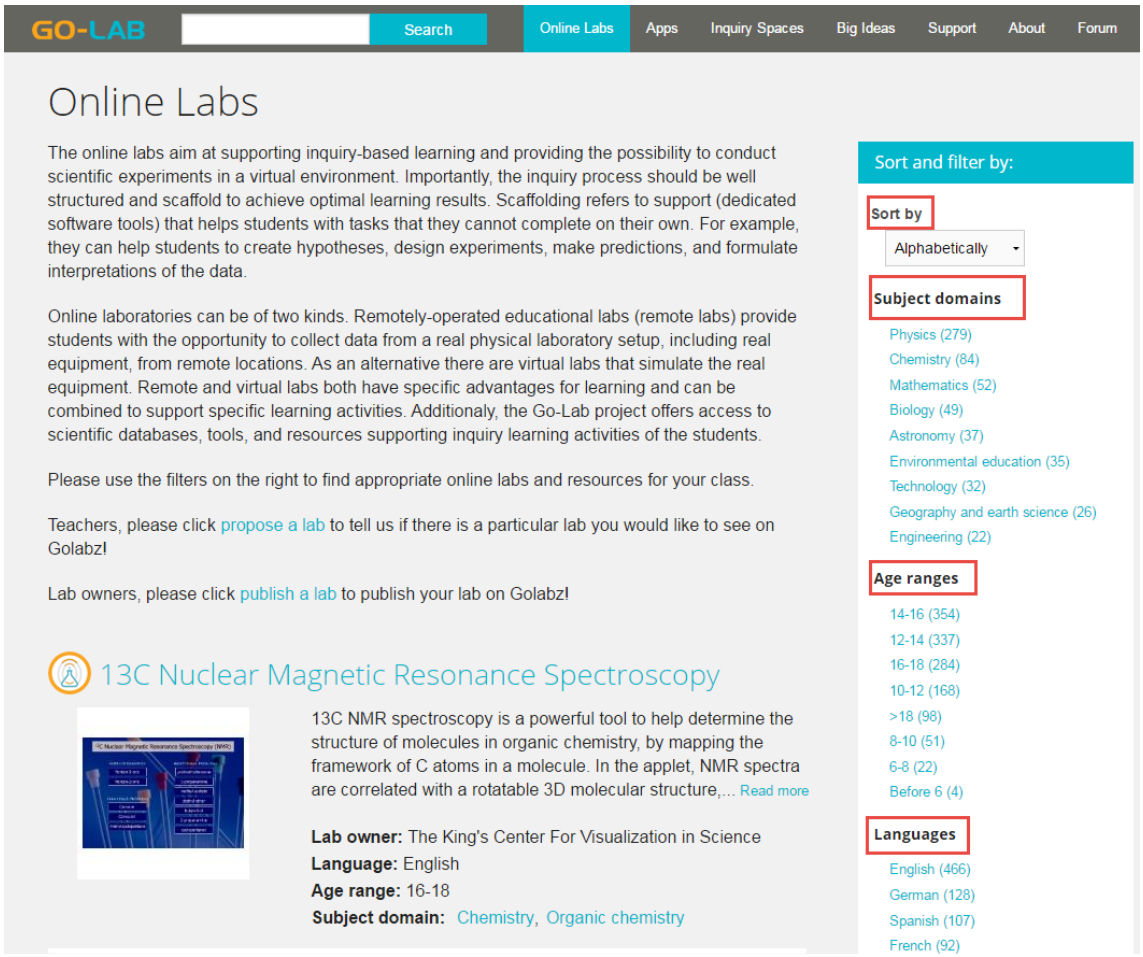

Figure 5. Right sidebar navigation

Apps, also known as tools or widgets, are small webs based software applications supporting specific learning or teaching goals and tasks in online labs (Figure 6). Apps can be added to a Inquiry Learning Space together with online labs. Apps are grouped within inquiry learning spaces according to their functionalities and purposes, and used to support particular experimenting and learning activities in online labs.

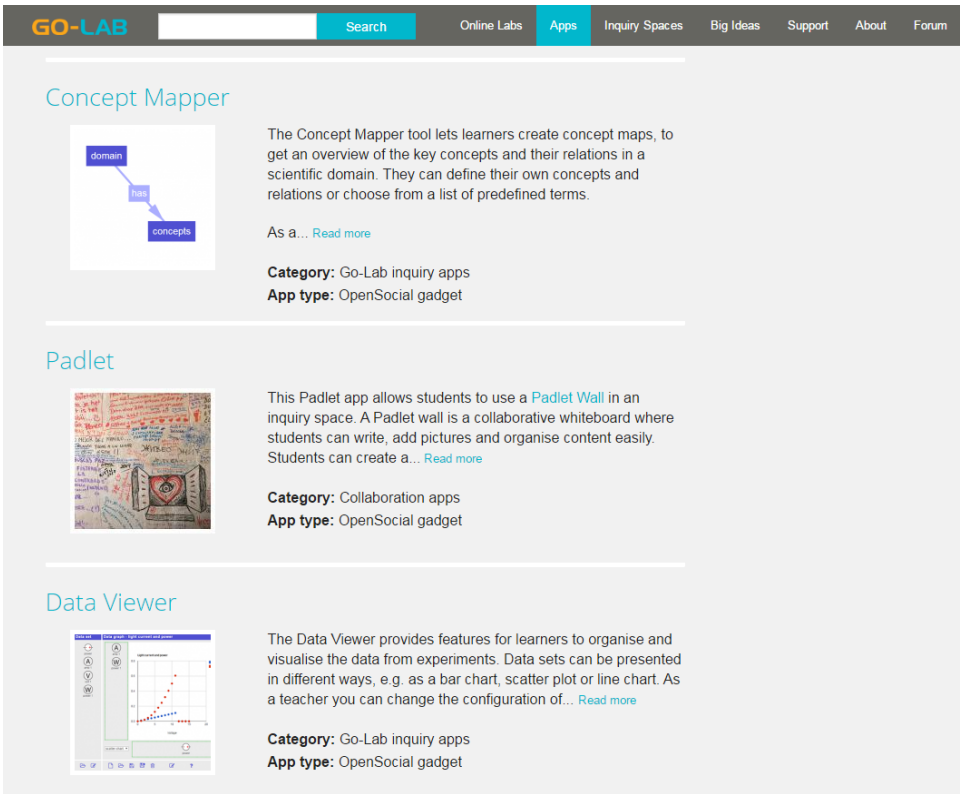

Fig. 6. Tools educational portal Go-Lab

In category *Big Ideas* described the laws of nature, physical phenomena, the development and evolution of living and so on. You can also find experiments and demonstrations that reveal the essence of the phenomenon that children learn and add resources to your lesson based on research (Fig. 7).

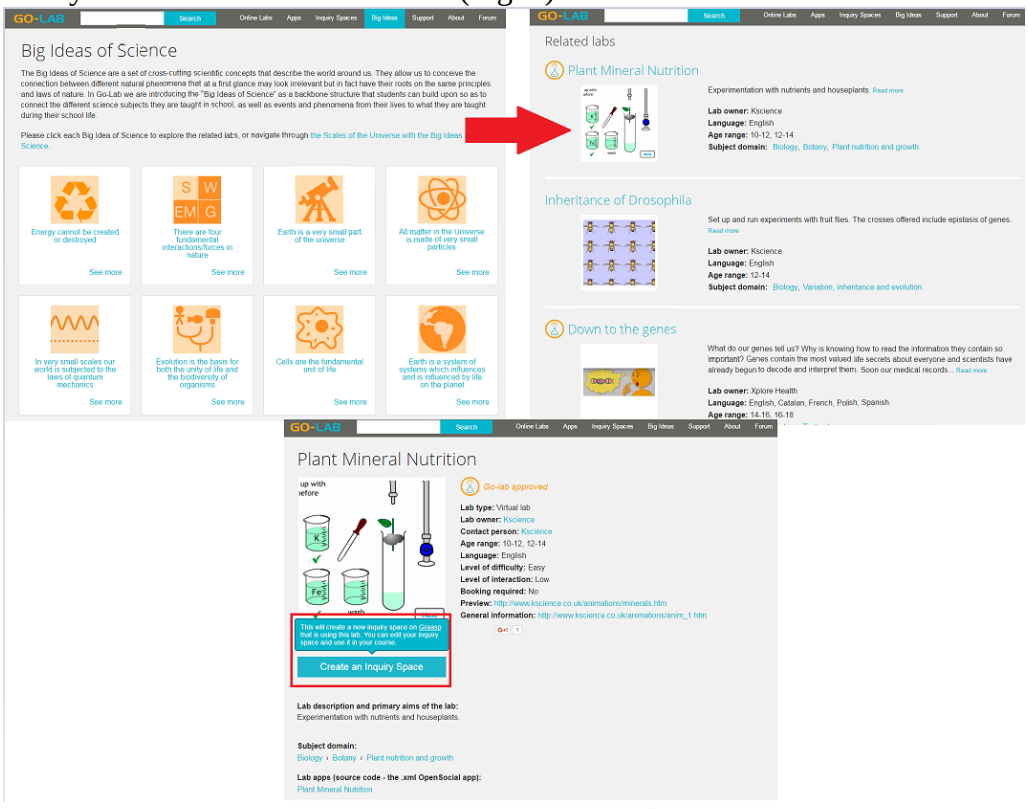

Figure 7. Category Big Ideas

After selecting resources for inquiry based learning teacher can move on to the second stage.

II stage. To create a comfortable learning environment for the student teacher has to create and generate a place for that child. You can use An Inquiry Learning Space (ILS). To get to it you must click on «Create An Inquiry Space» (Fig. 7). When you authorize on the home page, you can change the language interface, view to which courses you were added and begin to create your learning environment (Fig. 8).

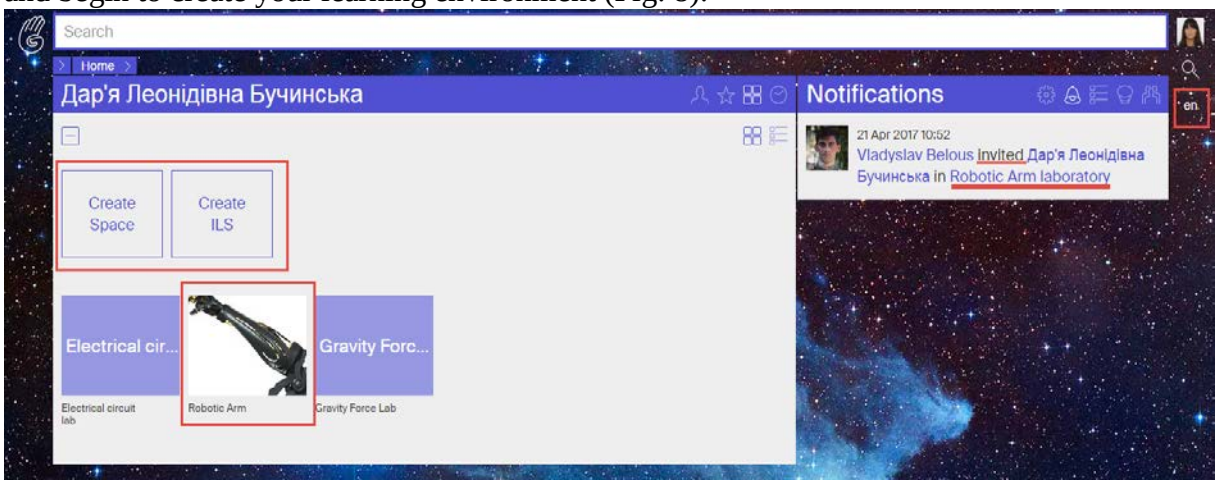

Figure 8. An Inquiry Learning Space

When creating or editing ILS you can give a name to the environment and complement its description; add users with different access rights; view usage statistics and activity of resource; adjust by using the Members; create discussion; share resources and more (Fig. 9).

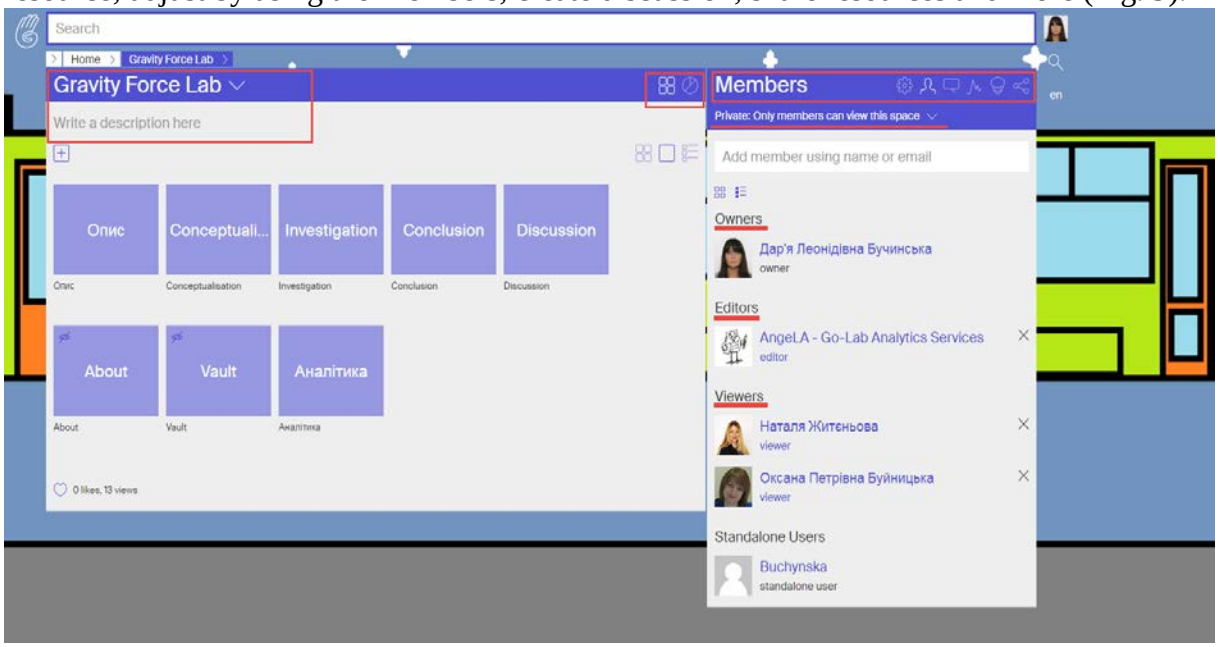

Figure 9. Tools ILS

In the section Investigation teacher creates an environment for the implementation of the research study. In this category, you can create a learning environment for different classes or different research projects and fill the necessary resources using such functionality as “create space”, “create document”, “add file”, “add link”, “add app”, “add lab” and “create discussion” (Fig. 10).

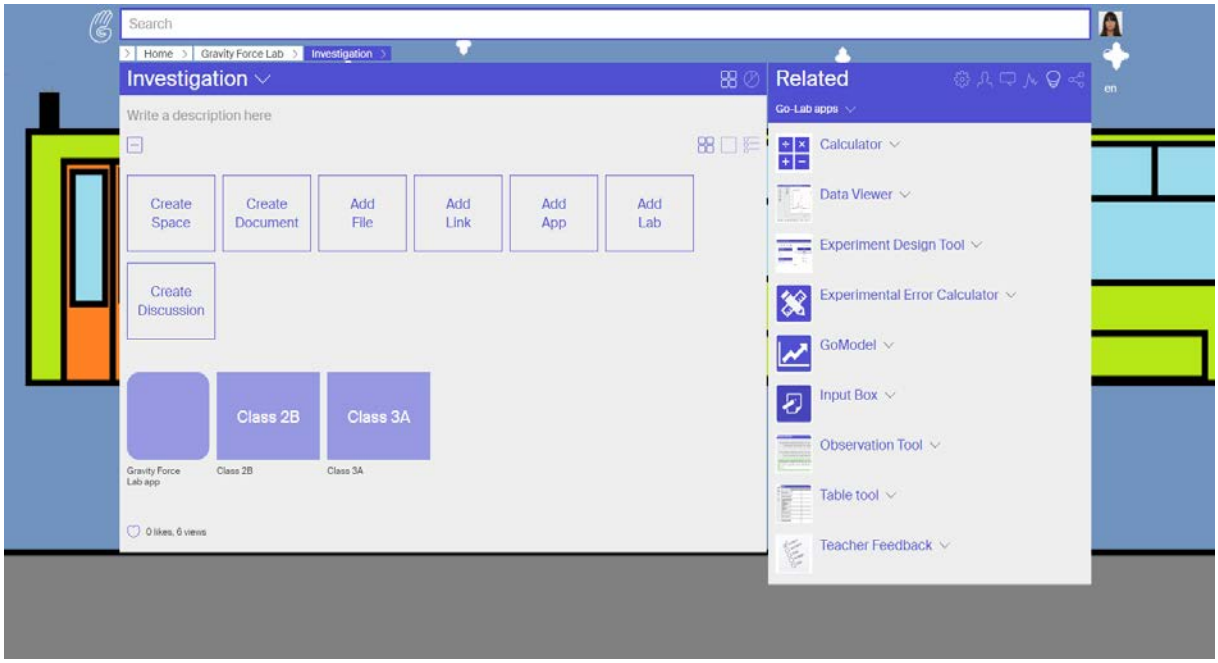

Figure 10. The section Investigation

III stage. After filling the learning environment just press the button «Show standalone view». In a new tab, copy the link and share with students. Who will work on the research project must enter their login for authentication in the system and start learning (Fig. 11).

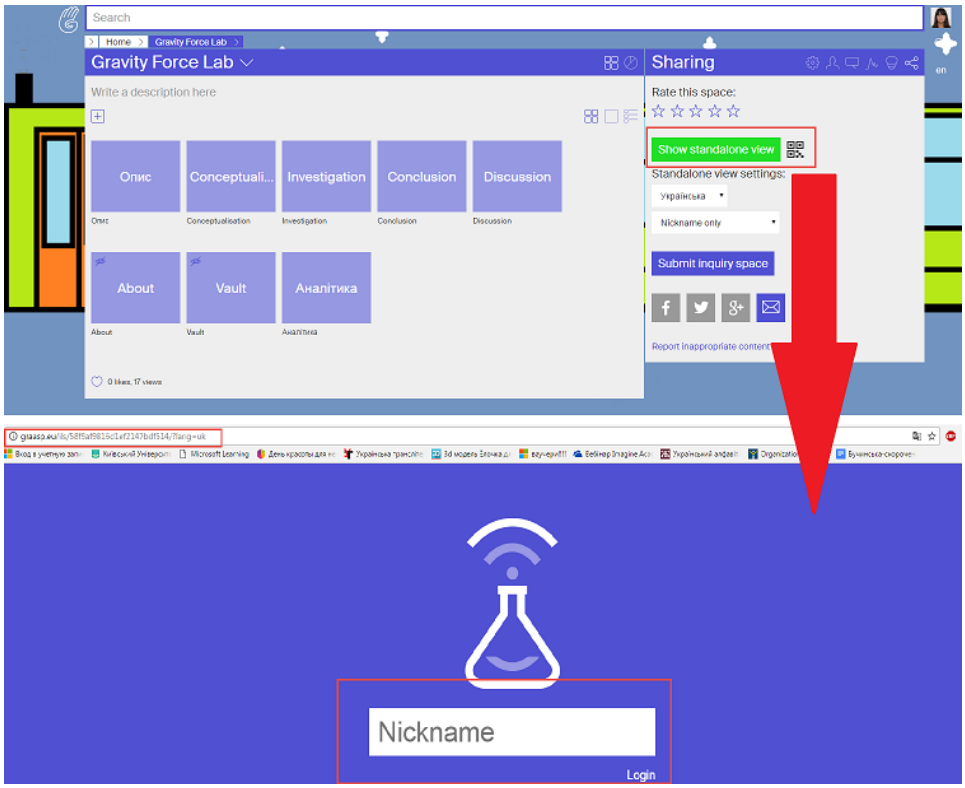

Figure 11. Adding students to the learning environment

Students work with this resource in 5 tabs (Fig. 12):

– Orientation (pupils see the description and Tutorials);

- Conceptualization (they formulate and document the hypothesis research questions and assumptions with the help of various apps);
- Investigation (the students plan and conduct scientific experiment this has contains the splash online lab and the experiment design tool which we have chosen while designing the LS);
- Conclusion (the students can summarize their findings);
- Discussion (writing tool padlet allowing students to gather the findings and a virtual whiteboard.

Moreover the students can reflect on the learning process for example that can check how long they worked in each phase compared with a long time in addition as a teacher). A teacher can use analytics tools to monitor your students work and learning progress).

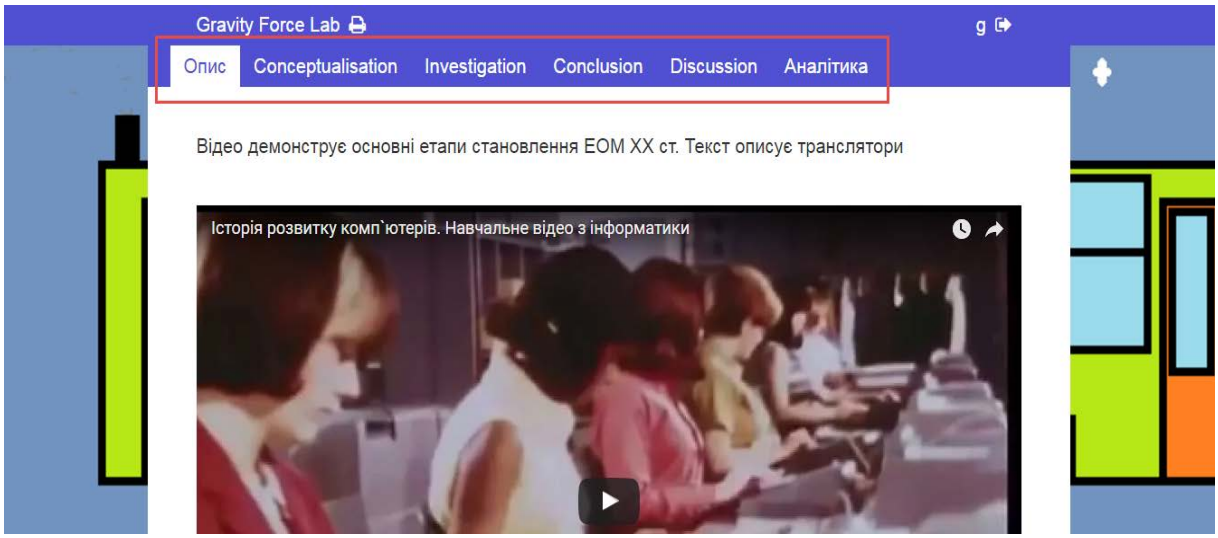

Figure 12. Resource with students work

Conclusions. Inquiry-based learning is a useful method that educators should embrace, as it helps to enhance the learning experience of students. The method gives children the opportunity to take a hands-on approach in their education while obtaining several important skills that can be used at all levels of their learning, and even into their future careers. Participating in research work, youth assimilate forms of social life, the participants of the research are not confined to personal interests, perform scientific research that helps to achieve sense of positive self-realization and their significance. Preparing the environment for conducting research is an important stage in this activity. Not all tools that can be used in inquiry-based learning satisfy the requirements of electronic educational resources of primary school. Therefore, selection of tools and development environments for research process is very important. Not every teacher is ready for implementation of inquiry-based learning, because of their lack of knowledge and unpreparedness to use the tools and resources. The use of modern technology in teaching activity requires from teacher not only high professional skills, but also determination, innovation and creativity. When creating and organizing learning environment teacher must take into account the peculiarities of perception, awareness and ability to process incoming and outgoing data object, phenomenon or process being investigated. Technical literacy of teacher must be high, in order for he shouldn’t loose while selecting a large number of cloud services and applications. Therefore, we see the need for further review and description tools for inquiry-based learning for students interested in learning, improve their mental alertness, motivation to work, develop skills of practical and creative application of acquired knowledge.

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